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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 156331.1 DAB	<b>FOR FURTHER ACTION</b>	
See Form PCT/IPEA/416		
International application No. PCT/IL2004/001090	International filing date ( <i>day/month/year</i> ) 28.11.2004	Priority date ( <i>day/month/year</i> ) 28.11.2003
International Patent Classification (IPC) or national classification and IPC H01L51/40		
Applicant PIXDRO LTD. et al.		

<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <ul style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of 8 sheets, as follows:           <ul style="list-style-type: none"> <li><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</li> <li><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</li> </ul> </li> <li>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)), containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</li> </ul>
<p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the opinion</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input checked="" type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>

Date of submission of the demand  01.09.2005	Date of completion of this report  22.02.2006
Name and mailing address of the International preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Wolfbauer, G Telephone No. +31 70 340-4811

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
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## Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
    - international search (under Rules 12.3 and 23.1(b))
    - publication of the international application (under Rule 12.4)
    - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

### Description, Pages

1, 2, 7-21	as originally filed
3-6, 6a	received on 01.09.2005 with letter of 01.09.2005

### Claims, Numbers

1-27	received on 01.09.2005 with letter of 01.09.2005
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### Drawings, Sheets

1/8-8/8	as originally filed
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a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3.  The amendments have resulted in the cancellation of:
  - the description, pages
  - the claims, Nos.
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):
4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
  - the description, pages 3-6,6a
  - the claims, Nos. 1-27
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. IV Lack of unity of invention**

1.  In response to the invitation to restrict or pay additional fees, the applicant has:
  - restricted the claims.
  - paid additional fees.
  - paid additional fees under protest.
  - neither restricted nor paid additional fees.
2.  This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
  - complied with.
  - not complied with for the following reasons:  
**see separate sheet**
4. Consequently, this report has been established in respect of the following parts of the international application:
  - all parts.
  - the parts relating to claims Nos. .

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	2,5,7,10,11,13,15,17,19-26
	No:	Claims	1,3,4,6,8,9,12,14,16,18
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-26
Industrial applicability (IA)	Yes:	Claims	1-26
	No:	Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Re item i.**

The applicant has submitted an amended set of claims. **Claim 1** as well as the description have been amended by the feature of "...to form a pattern ... **not requiring masking** ... of the layer". There is no basis in the application as originally filed for disclaiming a masking step. The description merely states on page 7 line 8 "... without resorting to complex patterning of the electrodes ...". From this phrase the skilled person cannot unambiguously derive that masking is not required. The incorporation of this feature into claim 1 may comply with Article 34(2)(b) PCT but will lead to an objection under Article 6 PCT (clarity). Newly filed **claim 13** now contains the feature of the ink not being light emitting whereas **claim 14** contains the feature of the ink not being electrically conductive. There is neither a basis in the application as originally filed for the ink being not light emitting but electrically conductive nor is there a basis for the ink being light emitting but not electrically conductive, as implied by the newly filed claims. The only basis for an amendment in regard to this feature is found in original claim 13 containing the feature "of an ink that is neither light emitting nor electrically conductive". That is, both features (light emitting and electrically conductive) are disclaimed simultaneously and not optionally. Consequently, the **amendments go beyond the disclosure of the application as filed** contravening Article 34(2)(b) PCT. Accordingly, this report was established as if such amendments had not been made (Rule 70.2(c) PCT). Thus, the **examination was based on the application as originally filed**.

**Re Item IV.**

The separate inventions/groups of inventions are:

**Invention 1: 1-22**

A device and a method to fabricate a patterned OLED.

**Invention 2: 23**

A decorative tile having a pattern formed on an OLED

**Invention 3: 24,25**

A stained glass panel on which is a patterned OLED

**Invention 4: 26**

A greeting card having a pattern formed on an OLED

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The inventions are not linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

According to Rule 13.1 PCT, "The International application shall relate to one invention only OR to a group of inventions so linked as to form a single general inventive concept". This is further clarified in Rule 13.2 PCT, which details that "the requirement for unity of invention shall only be fulfilled when there is a technical relationship among those inventions involving one or more of the same corresponding special technical features that defines a contribution which each of the claimed inventions, considered as a whole makes over the prior art".

The only feature being common to all of the inventions listed above is a patterned OLED.

To decide whether this technical feature is a special technical feature the teaching of Rules 13.1 and 13.2 PCT need to be applied, which stipulate that the technical feature must define a contribution over the prior art in order to be recognised as the special technical feature (which gives rise to unity).

EP1351303A2 discloses a method to manufacture images using an organic light-emitting display, for example fig. 4 discloses a patterned OLED.

Therefore, there is no special technical feature present, which would define a contribution over the prior art. Consequently, the inventions are not linked by a general inventive concept so that they would meet the requirement of unity.

The inventions were grouped using a *prima facie* approach. That is, the individual claims were grouped when common technical features between them were found to be present, which could constitute special technical features in the meaning of Rule 13 PCT.

**Re Item V.**

**1. Documents**

The following documents are cited in this report:

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D1: EP-A-1 351 303 (EASTMAN KODAK COMPANY) 8 October 2003 (2003-10-08)  
D2: US-B1-6 582 756 (ANTONIADIS HOMER ET AL) 24 June 2003 (2003-06-24)  
D3: WO 98/03043 A (HEWLETT-PACKARD COMPANY) 22 January 1998 (1998-01-22)

**2. Clarity**

The application **does not comply** with Article 6 PCT because the following **claims** are **not clear**:

**Claim 1** states "... whose contour ... does not require pre-shaping of the layer". The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result. For the purpose of assessing the application according to Article 33 PCT it was assumed that the emissive part of the OLED is less than the overlap of the electrodes.

**Claim 2** defines the additional feature of "generating half tone color separation masks ...". The skilled person does not know what he needs to do in order to generate a "half tone color separation mask". The phrase itself is not commonly known in the art of OLEDs nor can it be found directly in the description. Since no further explanation can be found in the description this feature was disregarded when assessing the application according to Article 33 PCT.

**3. Novelty and Inventive Step**

**3.1 Independent Claim 1**

D1 discloses (the references in parentheses refer to this document)

A method to fabricate an OLED device displaying an image (claim 4) comprising

- printing the pattern of said image using a light emitting ink (col. 4 lines 12-16)
- disposing an insulating material on the electrode on the areas where no light emission is desired (**par. 24**)
- providing a cathode and anode (fig. 5 layers 14 and 40)

Therefore the subject-matter of **claim 1 is not novel**.

**3.2 Dependent Claims 2-11**

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The additional features of claims 2-11 are either not new, **obvious in combination with D2** (see specifically col 3 lines 44-48 and col. 4 line 66 - col. 5 line 10) or generally known in the art.

**3.3 Independent Claim 12**

The subject-matter of device **claim 12 is not novel** for the same reasons as for method claim 1.

**3.4 Dependent Claims 13-22**

The additional features of claims 13-22 are either not new, obvious in combination with D2 (see specifically col 3 lines 44-48 and col. 4 line 66 - col. 5 line 10) or generally known in the art.

**3.5 Independent Claims 23, 24, 26 and Dependent Claim 25**

The use of patterned OLED for decorative purpose is suggested in D1 ( par. 1-3) and D3. Consequently, the subject-matter of the above mentioned claims is **not inventive**.

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Where UV light strikes the photoresist, it will be "cured" (hardened) and the remaining, unexposed photoresist is washed away. This leaves a patterned insulated layer that inhibits emission of light in the patterned area, thus creating a display of complementary pattern to the non-insulated area.

5 US 6,582,756 (Antoniadis *et al.*) published June 24, 2003 and entitled "*Method and apparatus for fabricating polymer-based electroluminescent displays*" discloses a method for fabricating an electroluminescent display and the substrate and apparatus used therein. The display is preferably constructed on a pre-constructed substrate that includes a flexible base layer having a conducting surface on one side thereof. The  
10 substrate includes a plurality of wells defined by a barrier layer formed by mask, each well having an electrode layer connected electrically with the conducting surface.

In all of the above-mentioned patent publications, the result will be a display depicting either the area of discontinuation in the insulating layer, or the area of the patterned electrode. To the observer the visual impression is the same whether the  
15 patterned image is implemented as a "negative" in the case of insulating material or as a "positive" as in the case of a patterned electrode.

The creation of a patterned insulating layer or a patterned electrode requires usage of masks and multi-step processing, and the need to change masks if different patterns are to be used in different displays. Moreover, in the case that more than one  
20 color is to be used in different regions, such approaches are extremely difficult to use, or even impossible.

Furthermore, US patent 5,902,688 requires full coating with expensive luminescent material, even when only a part of the coating is to be used actually.

OLED display panels which are based on light emitting polymers have a  
25 relatively simple multilayer structure as depicted in Fig. 1 and comprise:

1. A transparent glass or plastic material base layer 1.
2. A relatively transparent anode 2 made of Indium-Tin Oxide (ITO) which is deposited on the transparent layer by sputtering.
3. A hole ejection layer 3, formed of an ultra thin coat of "PEDOT" (polyethylenethioxythiophene) or similar material. Such layer can be made by spin coating, doctor blade coating or by ejection from ink jet mechanisms.

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4. An electron ejection layer 4, which is the luminescent layer, made of conjugated polymers or phosphorilated conjugated polymers of a PPV or polyfluorene structures. For the sake of brevity these are shown in the figure and will be referred to as PPV.

5. A cathode 5 made of Ca, Au or Al deposited by sputtering on layer 4, or applied as a foil. This layer, as well as layer 4, does not need to be transparent

6. A sealing layer (not shown) that seals the other layers from water and oxygen.

The thickness of all layers combined can be sub-millimetric, and if plastic material is selected for the base, this type of flat panel display can be folded or made to conform to curved surfaces.

Most of the currently available PLED flat panel displays are structured to display dynamic images and have a multiplicity of addressable picture elements so that the display is changeable dynamically, up to the level where superb video images can be displayed.

15 US patent 6,565,231 (R.S.Cok) published May 20, 2003 and entitled "*OLED Area Illumination Lightning apparatus*" discloses an electroluminescent display device having a substrate, anode, cathode, and organic electroluminescent layer and encapsulating cover. The two electrodes extend out of the device and are connected to a power source. This patent relates to multiple illuminated panels arranged in various 2D and 3D 20 self standing illumination combinations. However, there is no suggestion to use more than one color per panel, or to incorporate the panels inside another device.

Fig. 13 of US patent 6,565,231 illustrates lighting fixtures in which two more light sources are juxtaposed edge-to-edge in a common line so as to provide decorative channels similar to stained glass. This is another example of the use of OLEDs to produce static, as opposed to dynamic, images. Moreover, the approach taught by US 25 patent 6,565,231 is different from that shown in above-mentioned EP 1 351 303 since in the case of US patent 6,565,231 there is no requirement to use electrodes that are pre-shaped to the desired display pattern. However, patterning is achieved using conventional lithographic techniques such as through-mask deposition, integral shadow 30 masking, laser ablation and selective chemical vapor deposition. There is no suggestion to print the pattern using process printing techniques. Nor is there any suggestion to

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achieve the look of stained glass in a single OLED panel having multiple colored pixels that define a static image that requires only a single pair of electrodes.

Moreover, the light-emitting layer disclosed in US patent 6,565,231 commonly consists of a host material doped with a guest compound or compounds where light emission comes primarily from the dopant and can be of any color. Alternatively, different colors may be achieved by providing colored, neutral density, or color conversion filters over the device. However, there is no suggestion to obtain different colors by the provision of triads of pixels corresponding to the three primary colors.

On the other hand, there is abundant information in the patent and other technical literature describing multicolor illuminated OLED devices in the form of active or passive display matrices that are structured as an X/Y matrix of pixels, each pixel containing one or more colored subpixels. But these, of course, require separate addressing and, in the case, of colored pixels require three address lines and three transistors per triad. Such OLED matrix devices are intended to be used as flat panel displays for TV, computer, PDA and cellular telephones displays and are structured to have a plurality of addressable picture elements so that the display is dynamically changeable in time, up to the level where superb video images can be displayed.

There are situations where a static unchanging image, in many cases having a multiplicity of colors, is required to be displayed. Examples are conventional still images as are displayed in advertising boards, museum artifacts and other similar exhibits, to name but a few. In such case, the provision of address lines and their associated circuitry is redundant and unnecessarily complex and expensive.

It would therefore be desirable to provide an OLED constructed to display a fixed, static pattern without the need to shape the anode and cathode, and without the need to cover the total area of the substrate with insulating layer. It would be a further advantage if the shapes and colors were formed by a similar process to process printing.

It would be a further advantage if the shapes and colors were formed by a process identical to process printing.

#### SUMMARY OF THE INVENTION

It is a principal object of the invention to use OLEDs for the display of fixed images.

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It is another principal object of the invention to display fixed images using a pixelized display whose pixels are not addressable.

It is yet another principal object of the invention to use an OLED to display a fixed image by printing the image directly on to a substrate without any need for masks to protect areas of the substrate.

Further objects of the invention relate to the use of OLEDs for the display of fixed patterned images having one or more colors per display, inside tiles similar in size and shape to ceramic tiles and whose illuminated images preferably use patterned or pixelized displays whose patterns or pixels are not individually addressable.

Preferably, such tiles are of sufficient strength so that they can bear pressure of an amount that conventional tiles are designed to withstand in walls or floors, and permit easy incorporation into construction elements such as walls, floor and ceilings, including also into such structures that are paved by conventional ceramic tiles.

In accordance with a preferred embodiment, the functionality of the OLED containing tiles is maintained in structures that are subjected to the severity of the elements or to have them embedded in water in the walls or floors of swimming pools.

Yet a further object of the invention is to provide an OLED device which when illuminated by exciting current will give a visual experience of a stained glass window.

It is another object of the invention to use OLEDs for the display of fixed images that function as "self" illuminated greeting cards, using processes identical or similar to conventional printing on paper while permitting the supporting structure to be not only flat but also curved, so that they can be maintained in an upright position on flat horizontal surfaces. Preferably, the functionality of such greeting cards is enabled by activating it only on command.

To these ends, the invention discloses an OLED and a method of production that lends themselves to easy and cost saving design of a fixed patterned display. The patterning of the displayed image can be done differently for each individual display, as the manufacturing process is as simple as printing by ink jet on paper. The invention proposes a way of patterning that does not require addressing by row and columns or the individual addressing of pixels and requires very few electrodes, even as few as two.

Thus, according to a first aspect of the invention there is provided a method for creating a static image capable of self-illumination, said method comprising:

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printing constituent pixels of said image using a light emitting ink on a layer of an organic light emitting diode (OLED) device so as to form a pattern whose contour is determined only by said pixels and does not require masking or pre-shaping of the layer; and

5 providing a cathode and an anode for applying voltage across the OLED.

According to a second aspect of the invention there is provided a device having a static image capable of self-illumination when activated, said device comprising:

constituent pixels of said image printed using a light emitting ink on a layer of an organic light emitting diode (OLED) device so as to form a pattern whose contour is 10 determined only by said pixels and does not require masking or pre-shaping of the layer.

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**CLAIMS:**

1. A method for creating a static image capable of self-illumination, said method comprising:  
 printing constituent pixels of said image using a light emitting ink on a layer of  
 5 an organic light emitting diode (OLED) device so as to form a pattern whose contour is determined only by said pixels and does not require masking or pre-shaping of the layer; and  
 providing a cathode and an anode for applying voltage across the OLED.
2. The method according to claim 1, including:  
 10 generating half tone color separation masks each corresponding to a respective color component of said pixels and to a neutral background color;  
 printing the pixels corresponding to the color components using respective light emitting inks; and  
 printing the pixels corresponding to the neutral background color using an ink  
 15 that is neither light emitting nor electrically conductive.
3. The method according to claim 1 or 2, further including activating a process printer so as to print said color components separately.
4. The method according to any one of claims 1 to 3, wherein a single anode and a single cathode are provided for activating all of said pixels simultaneously thus  
 20 avoiding a need for separate addressing of selected pixels.
5. The method according to any one of claims 1 to 4, wherein said pixels are printed on a PEDOT layer or a cathode of the OLED.
6. The method according to any one of claims 1 to 5, wherein the pixels are formed using different colored light emitting inks.
- 25 7. The method according to any one of claims 1 to 6, wherein light saturation of selected pixels is varied by depositing a greater thickness of light emitting ink where higher saturation is required.

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8. The method according to any one of claims 1 to 7, wherein said pixels are printed using ink jet technology.
9. The method according to any one of claims 1 to 8, further including processing the image as in conventional printing to effect compensation and/or adjustment of the image.  
5
10. The method according to any one of claims 1 to 9, wherein the processing includes pre-processing the image by screening and dithering.
11. The method according to any one of claims 1 to 10, further including encapsulating the layer having said the pattern printed thereon within a device.  
10
12. A device having a static image capable of self-illumination when activated, said device comprising:  
constituent pixels of said image printed using a light emitting ink on a layer of an organic light emitting diode (OLED) device so as to form a pattern whose contour is determined only by said pixels and does not require pre-shaping of the layer.  
15
13. The device according to claim 12, wherein pixels corresponding to a neutral background color are formed of an ink that is not light emitting.
14. The device according to claim 12 or 13, wherein pixels corresponding to a neutral background color are formed of an ink that is not electrically conductive.  
15
15. The device according to any one of claims 12 to 14, including a single anode and a single cathode for activating all of said pixels simultaneously without requiring separate addressing of selected pixels.  
20
16. The device according to claim 12 or 13, wherein said pixels are printed on a PEDOT layer or a cathode of the OLED.  
25
17. The device according to any one of claims 12 to 16, wherein the pixels comprise different colored light emitting inks.

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18. The device according to any one of claims 12 to 17, wherein a thickness of selected ones of said pixels is varied according to a predetermined light saturation to be associated with said selected pixels.
19. The device according to any one of claims 12 to 18, wherein said pixels are printed using ink jet technology.
20. The device according to any one of claims 12 to 19, being a decorative tile.
21. The device according to any one of claims 12 to 19, being a stained glass window having a single panel on which are printed contiguous areas of light emissive color.
22. The device according to claim 21, further including black lines printed so as to overlap a respective common boundaries between contiguous colored areas.
23. The device according to any one of claims 12 to 19, being a greeting card.
24. A decorative tile having a pattern formed on a layer of an OLED.
25. A stained glass panel on which are deposited contiguous areas of light emissive color on a layer of an OLED.
26. The stained glass panel according to claim 25, further including black lines deposited so as to overlap a respective common boundaries between contiguous colored areas.
27. A greeting card having a pattern formed on a layer of an OLED.

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